Beverage Tests

ID: 6496

Time required: 1 class period
Suggested Grade Levels: 6–8

Activity Overview

In this activity, students will pour samples of common beverages/liquids into sample cups, and use the EasyLink with a pH sensor and the EasyData App to test their pH levels. Then they will choose a graph that will compare the liquids by their pH readings.

Objectives

- *Become familiar with the pH scale*
- *Determine the pH of a liquid*
- *Create graphs comparing pH levels*
- *Compare the same data displayed as a scatterplot, a boxplot, and histogram, and a bar graph*

Materials

- *TI-84 Plus family*
- *Vernier EasyLink & pH probe*
- *Vernier EasyData Application*
- *Distilled water for rinsing sensor*
- *Beaker or container for rinse water*
- *Beverage samples*
- *BeverageTests_Student.doc*
- *L1.8xl, L2.8xl*

Teacher Preparation

- *Use small plastic bathroom cups housed in egg cartons for the beverage samples.*
- *Students can provide a variety of popular beverages to test. Include tap water, milk, orange juice, lemonade, Kool-Aid, tea, soda, coffee, and so on. As a hypothesis, students can rank beverages from least to greatest by acidity; just predict acid, neutral, or base for each sample; or both.*

  ***Caution**: Be sure to consider that some students may be allergic to some beverages.*
- *Provide distilled water for rinsing the pH sensor between trials. Crook-necked bottles work well.*

Setup

Briefly discuss the data collection procedure with the class. Demo the activity using the overhead calculator so the entire class can see the process. If you only have one EasyLink and pH sensor, link the data lists to the class after running the activity. If you have enough equipment, have the students work in small groups. Use small plastic or waxed paper cups for the beverage samples. Provide a variety of popular beverages to test. Suggestions for liquids to test are tap water, milk, orange juice, lemonade, tea, soda, and coffee. As a hypothesis, students can rank beverages from least to greatest by acidity or they could predict acid, neutral, or base for each sample. They could also predict both. It is a good idea to have at least one sample of something you would not drink. In the example, the last sample is ammonia.

Caution: Be sure to consider that some students may be allergic to some beverages.

Provide at least 125 ml of distilled water for rinsing the pH sensor between trials. Crook-necked bottles work well. Be sure all containers are very clean. Each group should have its own water for rinsing between samples. Since the order the readings are taken is not important, have a few clearly marked samples of each liquid in one area of the room. Students can carry one or two samples at a time from that area to the area where their group is working. After taking those readings, the samples can be returned.

Classroom Management

- Assign these student jobs for this lab:
  - Materials/setup person (sets up EasyLink, pH sensor, and TI-84 Plus: holds probe in sample during activity, rinses probe in water between samples)
  - Tech person (operates EasyDataApp and TI-84 Plus)
  - Data recorder (reads and records pH readings for each sample on the worksheet)
  - Runner (brings samples to group, holds cup to avoid spillage during activity, and returns samples after readings are taken)

  Note: *pH sensor must remain in buffer solution bottle (packaged with the sensor) when not in use. If the sensor becomes completely dry, it will stop working.*

Worksheet – Sample data for table

Sample Number	Beverages	Actual pH	Actual pH description	Rank (1 = most acidic)
1	Water	6.94	Neutral	7
2	Vinegar	3.2	Acid	2
3	Salt Water	5.67	Acid	6
4	Soda	3.26	Acid	3
5	Apple Juice	4.09	Acid	4
6	Milk	6.81	Neutral	6
7	Lemon Juice	2.69	Acid	1
8	Ammonia	11.45	Base	8

The Problem

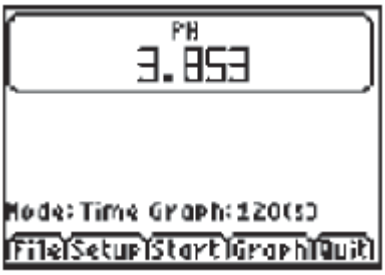
Are most of the beverages you drink each day acids, neutral, or bases?

Hypothesis

Before testing, answer the Questions 1 and 2 on the **worksheet** pages to predict the pH of some common beverages. Fill in the chart with the beverages you are using in the experiment.

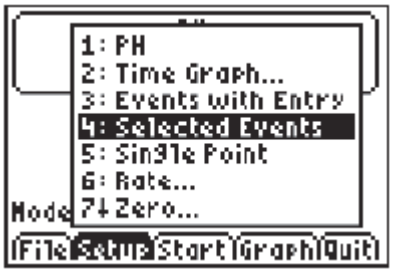
Collecting the Data

1. Connect the EasyLink to your TI-84 Plus using the mini-USB port.
2. Connect the pH sensor to the other end of the EasyLink.
3. The EasyData App will launch automatically. The EasyData information screen is displayed for about 3 seconds followed by the main screen. The App identifies the pH sensor. The main screen of EasyData is shown on the right.

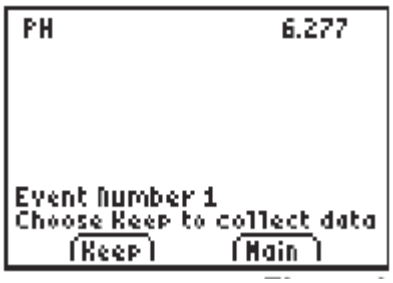


4. Press [Y=] to access the **File** menu and select **1:New** by pressing [1] or, since **1:New** is highlighted, you can press [ENTER]. This resets the program and clears out old data.

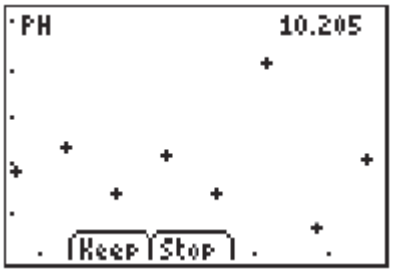
5. Press **Setup** and choose **4:Selected Events**. This setting will allow you to control when readings are taken.



6. Unscrew the cap from the pH sensor's storage bottle. Slide the cap up the probe so it is out of the way but do NOT remove it from the probe's shaft. Rinse the probe in the distilled water. Select Start to begin collecting data. You will see the current pH in the upper right corner of the screen. Let the water be your first reading. Wait for the pH reading to be stable and then select Keep to take the reading. Be sure to record it on your worksheet.

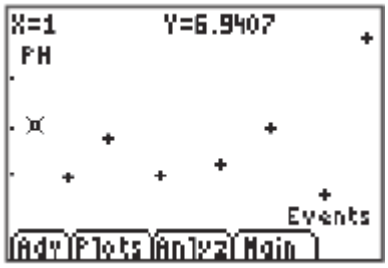


7. Insert the probe into the second sample and wait for the reading to become stable. Select **Keep** to collect the pH reading. Continue for a total of 8 trials (or the number of samples you have). With each recorded value, a new data point will be displayed on the graph with the option to **Keep** or **Stop** the data collection. The **Selected Events** feature will keep track of which reading you are on, increasing it by one each time you select **Keep**.

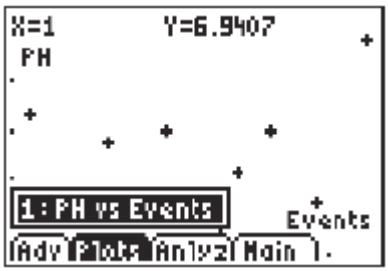


Note: After each reading, the pH sensor should be rinsed in the distilled water before being used for the next reading. The recorder should be filling in the chart on the worksheet with each beverage and its pH reading.

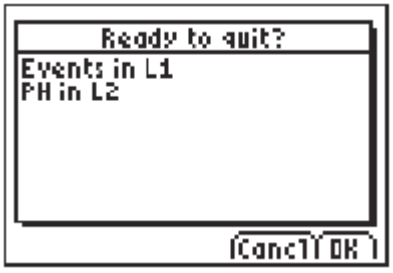
8. When all samples have been measured, select Stop. A graph of your data points will be displayed. At this time, you can use the right and left arrow keys to view the values of the coordinates of the points. Have students double-check these values with what was recorded in the chart.



9. To confirm a description of the plots, select **Plots**. You should see a confirmation that the points graphed are the **pH** values **vs.** the **Events** numbers. Be sure your students identify the Events number as the independent variable and the pH reading as the dependent variable.

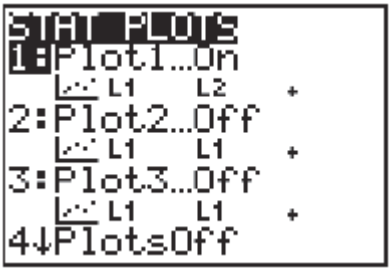


10. Select **Main** and then select **Quit**. A screen displays where the data from your activity is being stored. Select **OK** to exit the App.



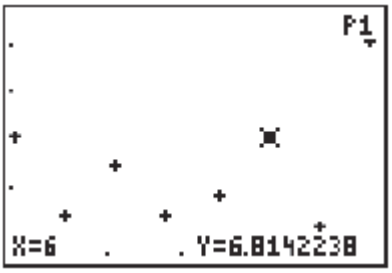
Data Analysis

1. Press [2nd] [Y=] to access the [STAT PLOT] menu; you will see that **Plot1** is turned on with the **L1** and **L2** data.



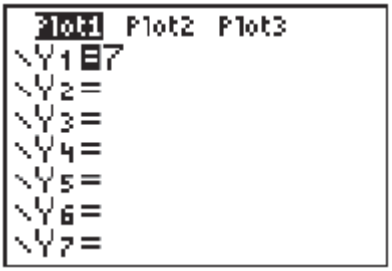
2. Press GRAPH and you will see the same graph that was displayed right before you left the App.

At this point, have students link the data lists so each student has **L1** and **L2** from the activity in his/her own calculator for the Data Analysis.

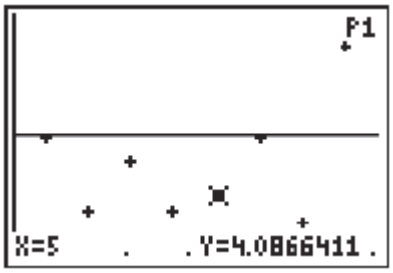


3. Have each student set up the same scatter plot on **Plot1** to display the pH data. Go to the Y= screen and graph a horizontal line at 7.

Press ZOOM and choose **9:ZoomStat** to view the graph. Have students sketch the scatter plot in the space provided on their worksheet. Discuss the meaing of the location of the points relative to the horizontal line at pH = 7.

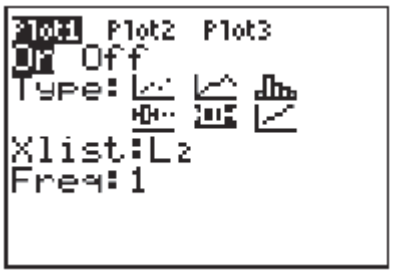


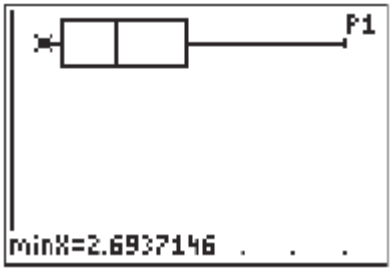
4. Have students trace through the points and discuss the meaning of the fact that most points are below the line Y = 7. Discuss the meaning of any points that are significantly different from the others.



5. Guide students in viewing the data as a box-and-wisher plot. First go to the Y= screen and clear **Y1**. Go back to **Plot1**, select the box-and-whisker icon, enter **L2** for the **Xlist**, and **1** for **Freq**.

Press ZOOM and choose **9:ZoomStat** to view the new graph. Have students sketch the box-and-whisker plot in the space provided on the worksheet. Have them trace the plot and move from one part of the plot to another, paying attention to the data at the bottom of the screen. Have students place the screen data in the appropriate place on the plot they are sketching on the worksheet.



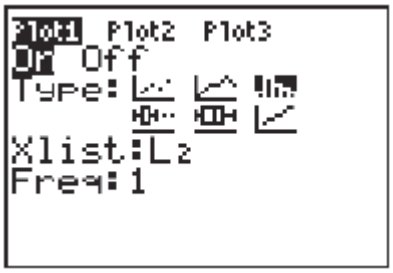


6. Lead your students in a discussion about observations that are easily made based on the length of both the whiskers and the boxes.

Exploration

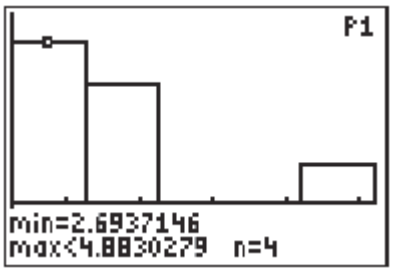
1. Guide students in presenting the data in a histogram. Adjust the **Plot1** setting to select a histogram rather than the boxplot just used.

Then press [ZOOM] and choose **9:ZoomStat** to view the new graph.

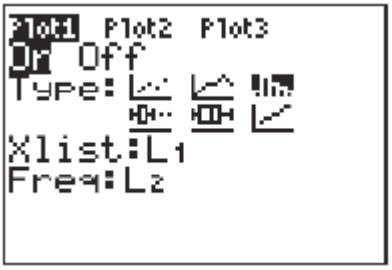


2. Press the right and left arrow keys to scroll through the bars. Discuss which graph they think gives more information about the data. Trace the data and make sure they see that the **n** at the bottom of the window is the number of items in the bar marked by the cursor. In the example here, 4 out of the 8 data collected were between 2.69 and 4.88.

Encourage students to adjust the window settings that will allow the graph to display the data in a more useful way.

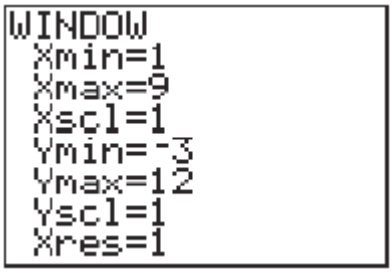


3. Before leaving this problem, show students how to display data to look like a bar graph by making a few adjustments to the histogram feature. In the [STAT PLOT] menu, go into **Plot1** and adjust the settings from above by entering **L1** for the **Xlist** and **L2** for the **Freq**.

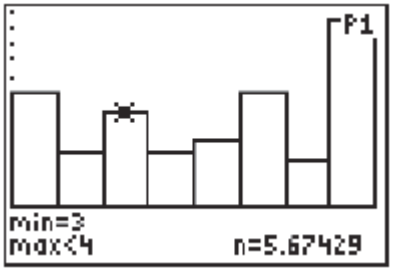


4. Press [WINDOW] and select appropriate settings. In the example, 8 items were measured. By setting the **Xs** from 1 to 9 with a scale of 1, there will be 8 bar generated, one for each item. The pH readings can only go from 0–14. In the sample, the highest reading was 11.45. The **Ymax** needs to be at least that height. The –3 for the **Ymin** will give space below the graph.

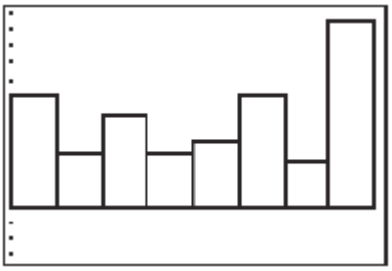
When the graph is traced, the numbers can be viewed without blocking part of the graph.



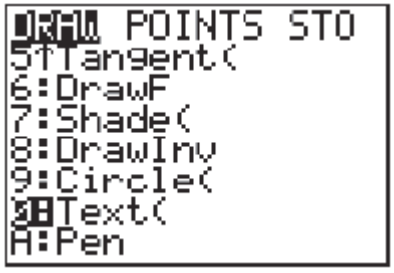
5. Press [GRAPH] and then [TRACE] to see that each bar represents one sample with the pH value being displayed beside the **n** at the bottom of the window.



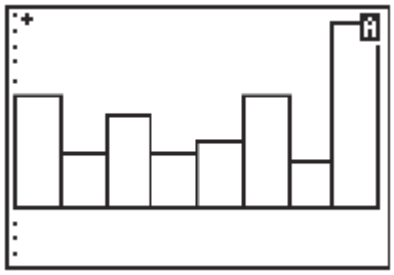
6. Pressing [GRAPH] again erases the data displayed at the bottom of the screen. The goal now will be to label this graph and save it as a picture in the calculator.



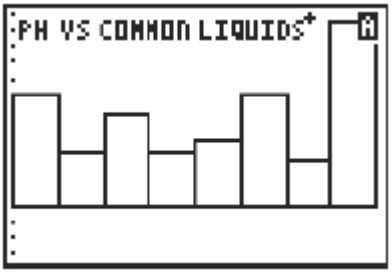
7. Press [2nd] [PRGM] to access the [DRAW] menu and arrow down until **0:Text(** is highlighted. Press [ENTER]. You will be taken to the graph screen. Remember, most menus are wrap-around menus, so you could also press the up arrow key twice to get to **0:Text(**.



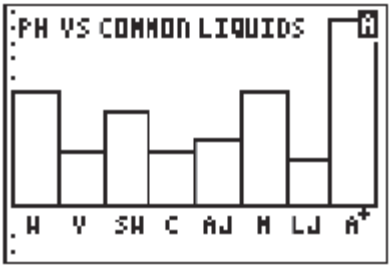
8. Your cursor is most likely near the center of the screen. Do **NOT** press [TRACE]. Just use the arrow keys to position the cursor to the upper left corner of the screen and then press [2nd] [ALPHA] to access the [A-LOCK] command. This will lock the calculator in **Alpha** mode so you can continuously type text across the screen. Notice the **A** in the upper right corner.



9. When you begin to type, you will notice that the text falls below and to the right of where the cursor is positioned. Give the graph a title. This example is titled, "**PH VS COMMON LIQUIDS**." Only uppercase letters can be used. For spaces, use [(-)] above the zero key. If you make a mistake and need to erase something, arrow back to the left of what you need to erase and press the zero key again. Anything you type will overwrite anything that is written below it. To erase things, type blank spaces over the error.



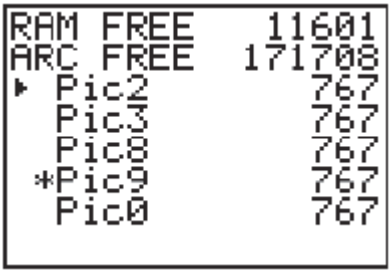
10. After the title is complete, use the arrow keys again to position the cursor below the first bar. You don't have much space, so use the first one or two letters as descriptors for the individual bars as demonstrated in the example, e.g., W for Water, V for Vinegar.



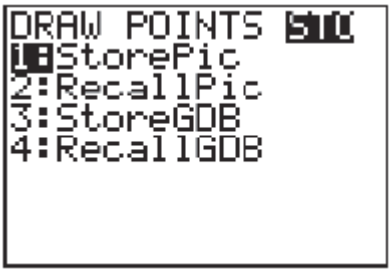
11. When finished, press 2nd [QUIT] to return to the home screen. You are going to store this picture in the calculator. There are 10 locations in which to save a picture. If there is already something in the location you choose, it will be overwritten with no warning. It is a good idea to first take a look at where pictures are stored.

12. Press 2nd [MEM]. Select **2:Mem Mgmt/Del** and press ENTER. Scroll down until **8:Pic** is highlighted and press ENTER.

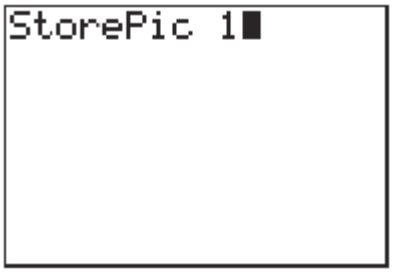
You will see a list of locations that are already filled with pictures. If you do not see any **Pics** listed, then there are no pictures stored in your calculator. The example shown here indicates that Pics 1, 4, 5, 6, and 7 are all available. The * in front of **Pic9** means it is archived.



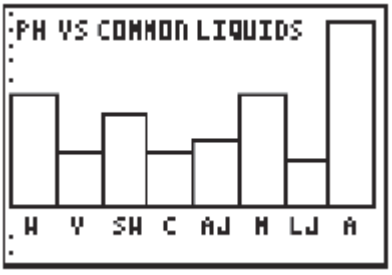
13. Press 2nd [QUIT] to return to the home screen. Press 2nd [DRAW] and arrow over to **STO**. **1:StorePic** is highlighted.



14. Press ENTER to select it and then type the number of the **Pic** where you want to store your picture. In the sample it will be stored in **Pic1**.

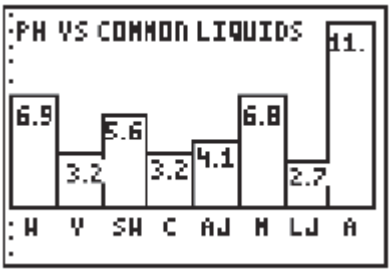


15. Pressing ENTER again will complete the command and return you to the graph screen. You could now delete all your data in the lists and/or turn off **Plot1** and this picture would remain intact. However, it is a stagnant picture. You will no longer be able to adjust the size of the window or trace the graph to view the coordinates.



Note: When you make a change to anything in Y= or [STAT PLOT], the drawing will be cleared from the display. To view it again, press 2nd [DRAW] and arrow over to **STO**. Select **2:RecallPic** followed by the number of the picture that was stored.

16. After saving the picture, have students see if they can add ot the drawing by putting in the pH values at the top of each bar. The process is the same as for adding letters to a drawing, but do not put the [A-LOCK] on to type numbers.



17. After adding the numbers, store the picture either in the same location as before or in a new location. Caution them to remember to press [2nd] [QUIT] to return to the home screen before trying to store the picture. If they forget that step, they could end up with the **StorePic** command in the middle of their picture as shown here. Unfortunately there is no “undo” command for this error.